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FAULT DIAGNOSIS AND CONDITION MONITORING OF WIND TURBINE USING ARDUINO

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Abstract : ***Wind energy is a clean and cheapest renewable energy source in the world. As the demand for wind energy continues to grow at exponential rates, reducing operation and maintenance (OM) costs and improving reliability became top priorities in turbine (WT) maintenance strategies. Wind turbines are very overpriced components in wind farms. The maintenance of turbine components takes extra money and time. The efficiency of power pro- duction depends upon the accuracy of the wind turbine. For these reasons, a relia ble condition monitoring system is important for the turbine to attenuate downtimes and increase productivity. This paper aims to monitor the wind turbine parameters and to improve early fault detection. Wind turbine monitoring system collects theparameters like Speed, Temperature, vibration, voltage, and current from turbine by using respective sensors. Thecondition monitoring system collects data from sensors and therefore the data are periodically updated within theroom. Arduino Uno board is employed for monitoring and control operations. The Arduino Uno board is interfacedwith the software named LabVIEW. If any anomalous condition occurs, the SMS are going to be sent to the operator by using the GSM Module.***

Keywords - Wind turbines (WTs), operation and maintenance (OM), condition monitoring, fault detection, de- structive tests, non-destructive tests, subsystem monitoring techniques

1. INTRODUCTION

In front of the large increase demand in energy over the planet, and so as to look a substitutional quite energy against the costs rise of the energy fossil fuel resources then its exhaustion reverse within the fu- ture. The development of this alternative is inspired because it offers natural, economic, clean and safe resource monitoring and diagnosis become essential to attenuate maintenance costs and ensure continuity of production, because stopped a wind installation for unexpected failures could lead on to expensive repair and to lost production. This OS stopped becomes critical and causes very significant loses, for this reason there's a rise got to implement tons efficient maintains, this online surveillance allows a regular early detection mechanical and electrical faults; it must able to put a stop to a major component failure the wind turbine becomes an important topic in scientific research and industries. The main objective of this project is to review the planning of a true time monitoring and controlling system for state supervision of windmill machine.

2. METHODOLOGY OF ANTENNA DESIGN

The following Technologies are going to be utilized in this project. Arduino Uno is a microcontroller board which support the ATmega328P. It consists of 14 digital input/output pins (of which 6 are often used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53R0), a USB connection, a power jack, an ICSP header and a button to reset.

Node MCU is an open source Lua based firmware as well as development board specially targeted for IoT based Applications. It includes firmware that's operated on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP12 module.

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Fig. 1: Arduino Based UNO

Fig.2: Node MCU ESP8266

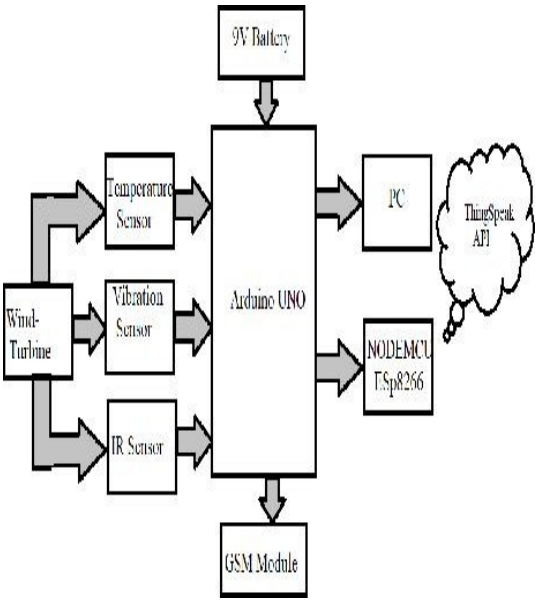

Fig.3: Block Diagram Representation

A turbine may be a device that converts the wind's kinetic energy into electricity. Wind turbines are manufactured during a good selection of sizes, with either horizontal or vertical axis. It is estimated that many thousands of huge turbines, in installations referred to as windfarms, now generate over 650 GW of power, with 60 GW added annually. They are an increasingly important source of intermittent renewable energy, and are utilized in many countries to lower energy costs and reduce reliance on fossil fuels. One study claimed that, as of 2009, wind had the "lowest relative greenhouse emissions, the smallest amount water consumption demands and the foremost favorable social impacts" compared to photovoltaic, hydro, geothermal, coal and gas.

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Table 1. MANUAL MONITORING SYSTEM VS AR- DUINO BASED MONITORING SYSTEM

MANUAL MONITORING SYSTEM	ARDUINO BASED MONITORING SYSTEM
It required more people to implement the monitoring system.	It required less than two people for installing the system.
Backup can be done on papers.	Backup can be done by software which is ever lasting.
Monitoring is interrupted in rain and snowfall.	Monitoring can be done in any condition.
The liability of the system is very low.	Monitoring can be done in any condition.
High maintenance and need of skilled technical labour.	Low maintenance and need of technical labour only.

Microstrip line feeding is used for the proposed antenna as it is easy to fabricate. The length and width of the slots determine the resonant frequencies of the antenna [10-11]. By changing the proportions of the length and width of the slots multiband characteristics may change. The optimized parameters of the slots are chosen for fabrication.

SIMULATION RESULTS

The sensors involved here are Temperature sensor, IR sensor and Vibration sensor. These sensors are connected to wind turbine to determine the condition of wind turbine. IR sensor is used to find the speed of turbine. Vibration sensor is used to find the vibration of the turbine and temperature sensor is used to find the temperature change. All these sensors gather information of the wind turbine and give it to Arduino micro-controller. We are using NODEMCU ESP 8266 to upload all the information in Thing Speak cloud Application. In the Thing Speak application, there are various fields and we can monitor different parameters in each field. Also, when there is some abnormal condition around the wind turbine then alert message will be send to all the authorized users. The sensor value is sent every second to the IoT cloud of Thing Speak of this project. When any foreign object enters the perimeter of the turbine. IR sensor will emit the light and displays "obstacle detected" which can be potential fault static. Another potential fault static was erotic vibrations produced by the turbine when motor turns at abnormally high as low speed, the vibration sensor detects if and displays "motor has created more torque". During such situation there is a chance of an increase in temperature – "getting high temperature" which is not advisable for the health of turbine. They detect almost all basic faults scenarios. Thing Speak API send these sensors data to web services, apps and other things.

$$\%bandwidth = \frac{f_u - f_L}{f_C} \times 100 \qquad (1)$$

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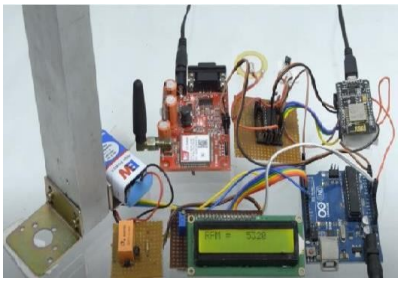

Fig.4: Circuit Diagram

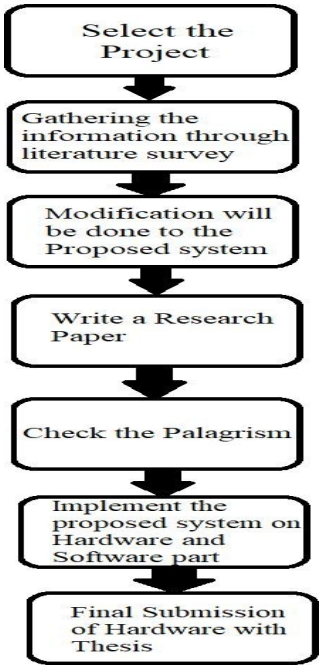

Fig.5: Project Execution Plan Diagram

3. CONCLUSION

Condition monitoring system is developed to measure the various parameters of the wind turbine. The Wireless communication enables the remote con- trolling system of these parameters from room. In view of the necessity to enhance the supply of WTs, the utilization of cost-effective, commercial, condition monitoring techniques, a simple, cheap but globally effective WT condition monitoring technique has been researched using a wavelet based adaptive

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filter. Experiments show that the proposed technique isn't only valid for detecting electrical faults in WT generator, but also effective in WT generator.
Monitoring mechanical faults in the drive train even though the rotational speed of the WT is constantly varying. The technique may be applied to all types of WTs because power signals are available from all of them.

REFERENCES

[1] W. Yang, P. Tavner, C. Crabtree, and M. Wil-kinson, "Cost-effective condition monitoring for wind turbines," IEEE Trans. Ind. Electron., vol. 57, no. 1, pp. 263–271, Jan. 2010.
[2] Z. Hameed, Y. Hong, Y. Cho, S. Ahn, and C.Song, "Condition monitoring and fault detection of wind turbines and related algorithms: A Re- view," Renewable Sustainable Energy Rev., vol. 13, pp. 1–39, 2009.
[3] P. Caselitz and J. Giebhardt, "Rotor condition monitoring for improved operational safety of off-shore wind energy converters," J. Sol. Energy Eng., vol. 127, no. 2, pp. 253–261, 2005.
[4] L. Y. Pao and K. E. Johnson, "Control of windturbines," IEEE Contr.Syst. Mag., vol. 31, no. 2, pp. 44–62, Apr. 2011.
[5] Wei Qi, Jinfeng Liu, Xianzhong Chen, Panagiotis D. Christofides, " Supervisory Predictive Control of Standalone Wind/Solar Energy Generation Systems" IEEE Transactions on Control System Technology vol 19 issue 1 Jan 2011.
[6] Hoa M. Nguyen, D Subbaram Naidu "Advanced control strategies for wind energy system : An overview" IEEE /PES Power Systems Conference and Exposition March 2011.
[7] Wenxian Yang, Richard Court, Jiesheng Jiang " Wind turbine condition monitoring by the approach of SCADA data analysis" Elsevier Renewable Energy vol 53,pp 365-376, May 2013
[8] X Fu, L He, H Qiu, "MEMS gyroscope sensors for wind turbine blade tip deflection measurement" IEEE, International Instrumentation and Measurement Technology Conference, July 2013.
[9] Irving P. Girsang, Jaspreet S. Dhupia, Eduard Muljadi, Mohit Singh, Member, and Jason Jonkman, "Modeling and Control to Mitigate Resonant Load in Variable-Speed Wind Turbine Drivetrain," IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 1, no. 4, December 2013.

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